Solution

Union College
ECE248 Semiconductor Devices and Circuits
Spring 2015
In-Class-Exercise – Common Emitter Voltage Amplifier

Use the circuit in figure 1 below and, V_T = 26mV, to make the following calculations:

a. Determine if the bias voltage divider is "stiff".
b. Compute the quiescent emitter current I_{EQ}.
c. Draw the AC small signal equivalent circuit and make sure to label the value of r_e
d. Compute the voltage gain V_{out}/V_{in}.
e. Compute the input impedance R_{in}.
f. Compute V_{out} when the AC signal source is V_s = 8 mV.

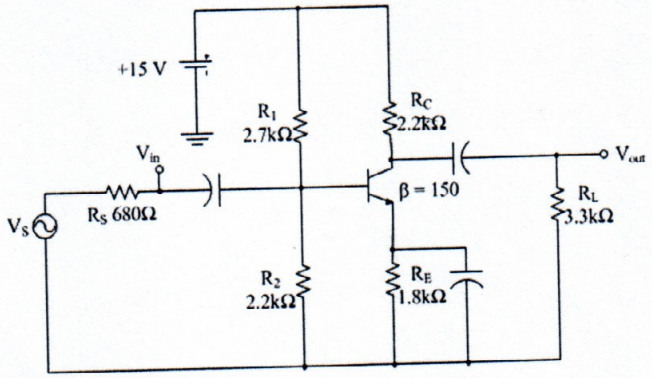


Figure 1 Common Emitter Voltage Amplifier

a. $R_1 || R_2 < \frac{1}{100}(\beta+1)R_E$

$2.7k || 2.2k = 1.2k$

$\frac{151}{100} \cdot 1.8k = 2.7k$] Yes

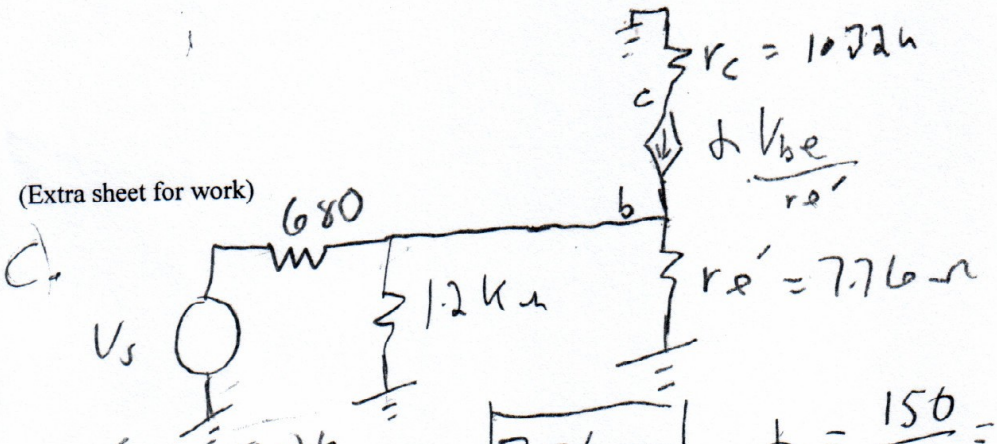
b. $V_{BB} = 15\left(\frac{2.2k}{2.2k+2.7k}\right) = 6.735V$

$V_E = V_{BB} - 0.7 = 6.035V$

$I_{EQ} = \frac{6.035V}{1.8k} = 3.35mA$

(Extra sheet for work)

c.



$r_e' = \frac{0.26}{3.35mA} = \boxed{7.76\Omega}$ $\quad \alpha = \frac{150}{151} = 0.993$

d. $\frac{V_{out}}{V_{in}} = -\alpha \frac{r_c}{r_e'} = -0.993 \frac{1320}{7.76} = \boxed{-168.9}$

e. $R_{in} = \underbrace{R_1 \| R_2}_{1.2k} \| (\beta+1) r_e'$

$R_{in} = 1200 \| \underbrace{(151)(7.76)}_{1171.8\Omega} = 592.9\Omega \approx \boxed{593\Omega}$

f. $V_{out} = \left(\frac{V_{out}}{V_s}\right) \cdot V_s = \left(\frac{R_{in}}{R_{in}+R_s}\right)\left(\frac{V_{out}}{V_{in}}\right) V_s$

$\left(\frac{593}{593+680}\right)(-168.9)(8mV) = \boxed{-629mV}$